

Claims

1. An apparatus for performing a photochemical reaction, comprising:
a reaction chamber for receiving a first molecular substance for photochemical conversion of the first molecular substance into at least two second molecular substances; and
at least one optical parametric oscillator for generating secondary radiation from primary radiation by parametric interaction of the primary radiation with an optically nonlinear medium, and for directing at least a portion of the secondary radiation into the reaction chamber to dissociate the first molecular substance into the at least two second molecular substances.
2. An apparatus as defined in claim 1, wherein the first molecular substance is a first hydrocarbon which is dissociated into at least one second hydrocarbon.
3. An apparatus as defined in claim 2, wherein the first hydrocarbon is methane and the at least one second hydrocarbon is ethane.
4. An apparatus as defined in claim 1, wherein the at least one optical parametric oscillator is an optical parametric oscillator/laser (OPOL) including an optical pump source for generating pump radiation, and an OPOL material responsive to the pump radiation to generate laser radiation and responsive to the laser radiation to generate parametric optical radiation.
5. An apparatus as defined in claim 1, further including an array of optical parametric oscillators surrounding at least a portion of the reaction chamber for directing at least

a portion of the secondary radiation generated by the array
5 into the reaction chamber.

6. An apparatus as defined in claim 1, further comprising a first compressor for compressing the first molecular substance prior to injection into the reaction chamber.

7. An apparatus as defined in claim 1, further comprising a heated nozzle for heating the first molecular substance prior to injection into the reaction chamber.

8. An apparatus as defined in claim 1, further comprising a distiller for removing and collecting at least a portion of at least one second molecular substance.

9. An apparatus as defined in claim 1, further comprising a heat exchanger for cooling the at least one optical parametric oscillator.

10. An apparatus as defined in claim 1, comprising a first stage and a second stage, wherein the first stage includes a first reaction chamber and a first at least one optical parametric oscillator for directing secondary
5 radiation into the first reaction chamber to dissociate the first molecular substance into at least two second molecular substances, and the second stage includes a second reaction chamber for receiving any residual first molecular substance from the first stage, and a second at least one optical
10 parametric oscillator for directing secondary radiation into the second reaction chamber to dissociate the residual first molecular substance into the at least two second molecular substances.

5 11. An apparatus as defined in claim 10, further comprising a first distiller for removing and collecting at least a portion of at least one second molecular substance from the first reaction chamber, and a second distiller for removing and collecting at least a portion of at least one second molecular substance from the second reaction chamber.

5 12. An apparatus as defined in claim 10, further comprising a first heat exchanger for cooling the at least one first optical parametric oscillator and a second heat exchanger for cooling the at least one second optical parametric oscillator.

13. An apparatus as defined in claim 1, wherein the reaction chamber includes means for controlling the polymerization of the photochemically activated substances.

5 14. A method for performing a photochemical reaction comprising the following steps: introducing a first molecular substance into a chamber; generating secondary radiation with at least one optical parametric oscillator; and directing at least a portion of the secondary radiation into the chamber to promote the reactivity of the first molecular substance.

2 15. A method as defined in claim ¹~~14~~ wherein the first molecular substance is dissociated into at least two second molecular substances.

3 16. A method as defined in claim ²~~15~~, wherein the first molecular substance is a hydrocarbon which is dissociated into at least one second hydrocarbon.

4 17. A method as defined in claim ³~~16~~, wherein the first hydrocarbon is methane and the at least one second hydrocarbon is ethane.

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5 18. A method as defined in claim 14, wherein the step of generating secondary radiation comprises employing at least one optical parametric oscillator/laser (OPOL) including an optical pump source for generating pump radiation, and an OPOL material responsive to the pump radiation to generate laser radiation and responsive to the laser radiation to generate parametric optical radiation.

11 19. A method as defined in claim ~~14~~¹, further comprising the step of compressing the first molecular substance prior to introduction into the chamber.

12 20. A method as defined in claim ~~14~~¹, further comprising the step of heating the first molecular substance prior to introduction into the chamber.

5 21. A method as defined in claim ~~15~~², further comprising the step of removing and collecting at least a portion of at least one second molecular substance by distilling the at least one second molecular substance.

6 22. A method as defined in claim ~~15~~², further comprising the steps of directing residual first molecular substance released from the chamber into a second chamber, generating secondary radiation with a second at least one optical parametric oscillator, and directing at least a portion of the secondary radiation into the second chamber to dissociate the residual first molecular substance into at least two second molecular substances.
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7 23. A method as defined in claim ~~22~~⁶, further comprising the steps of removing and collecting at least a portion of at least one second molecular substance from each chamber by distilling the at least one second molecular substance.

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24. A method as defined in claim 22, further comprising
the step of recirculating residual first molecular substance
released from the second chamber back through the second
chamber to dissociate the residual first molecular substance
5 into at least two second molecular substances.

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25. A method as defined in claim 17, wherein the
secondary radiation is within the region of approximately 3.0
microns.

26. A method as defined in claim 17, wherein the
secondary radiation is within the ultraviolet region.